WHITE PAPER
RECOMMENDATIONS OF INTERNATIONAL PAPER AND MCGINNES INDUSTRIAL MAINTENANCE CORPORATION TO U.S. EPA ON THE APPROPRIATE FINAL REMEDY FOR THE SAN JACINTO RIVER WASTE PITS SUPERFUND SITE

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LIST OF ACRONYMS AND ABBREVIATIONS

2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
2,3,7,8-TCDF	2,3,7,8-tetrachlorodibenzofuran
AOC	Agreement and Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
BMP	best management practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CNRE	comparative net risk evaluation
COC	chemical of concern
cy	cubic yard
FS	Feasibility Study
I-10	Interstate Highway 10
IC	institutional control
IP	International Paper Company
MIMC	McGinnes Industrial Maintenance Corporation
MNR	Monitored Natural Recovery
NCP	National Contingency Plan
NTCRA	Non-Time Critical Removal Action
OMM	Operations, Monitoring and Maintenance
PCB	polychlorinated biphenyl
PCL	Protective Concentration Level
PM	particulate matter
RAO	Remedial Action Objective
Respondents	McGinnes Industrial Maintenance Corporation and International Paper Company
RI	Remedial Investigation
Site	San Jacinto River Waste Pits
S/S	solidification/stabilization
SWAC	surface-weighted average concentration
TCRA	time critical removal action
$TEQ_{DF,M}$	Toxicity equivalent concentration calculated for dioxin and furan

	congeners using toxicity equivalency factors for mammals
TMV	toxicity, mobility and volume
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

This White Paper sets forth the basis for International Paper Company's (IPs) and McGinnes Industrial Maintenance Corporation's (MIMCs) recommendation to the United States Environmental Protection Agency (USEPA) to select Alternative 3N in the Feasibility Study (FS) as the final remedy for the impoundments in the northern area (the Northern Impoundments) of the San Jacinto River Waste Pits Superfund Site (the Site). IP further recommends that Alternative 2S be selected for the southern area of the Site (the "Southern Area").[1] Alternative 3N is a permanent multi-layered armored cap that provides a full and complete protective remedy by isolating the waste materials in the Northern Impoundments. It can withstand a 100-year storm event and a 500-year flood event. In addition, considering the criteria specified in the National Contingency Plan regarding costs, Alternative 3N is the most cost-effective alternative addressed in the FS. Under Alternatives 4N, 5N, 5aN, and 6N, by contrast, the existing armored cap would be partially or fully removed, the waste under the armored cap would be disturbed, impacted sediments would be resuspended, and the exposed materials would be subject to potential storm or flood, thereby increasing risks to the environment. Furthermore, these alternatives are less cost-effective than Alternative 3N.

Similarly, Alternative 2S for the Southern Area would provide a full and complete protective remedy against the only potential risk -- exposure of potential future construction workers -- by placing deed restrictions in three discrete areas. This is also the most cost-effective remedy for the Southern Area, because no material incremental protectiveness would be achieved by excavation.

The Northern Impoundments

In May 2010, IP and MIMC (collectively referred to as the "Respondents") entered into an Administrative Order on Consent (AOC) with USEPA pursuant to which the Respondents agreed to undertake a time critical removal action (TCRA) relative to the Northern Impoundments to stabilize and isolate the materials in the impoundments within an armored cap. The cap was engineered using armor stone, geotextile and geomembrane (the "Armored Cap") and designed to United States Army Corps of Engineers (USACE) standards to

[1] MIMC was not involved in the remedial investigation for the Southern Area and thus makes no recommendation for that area.

withstand a 100-year storm and a 500-year flood event. The construction of the Armored Cap was completed in July 2011 at a cost of approximately $9 million. The Armored Cap was enhanced in 2014 pursuant to USACE recommendations.

The FS presents seven remedial alternatives for the Northern Impoundments. Under Alternatives 1N and 2N the Armored Cap would remain as designed and further enhanced in accordance with USACE recommendations. Under Alternative 3N, the Armored Cap would be strengthened and made permanent by adding additional armoring, further flattening the slopes, and adding a berm to protect the Armored Cap from vessel traffic (the "Permanent Cap"). Under Alternatives 4N, 5N, 5aN, and 6N, the Armored Cap would be temporarily or permanently removed while dredging and/or solidification of the underlying waste materials took place over a 16 to 19 month period. IP and MIMC recommend that USEPA select Alternative 3N (which would enhance the Armored Cap) for the following reasons:

1. <u>Conversion Of The Armored Cap Into An Even Stronger Permanent Cap Is Consistent With CERCLA And The National Contingency Plan (NCP)</u>. Incorporating the protective Armored Cap into the final remedy would be consistent with the provisions of CERCLA Section 104(a)(2) and NCP Section 300.430(a)(ii)(B) which stress that removal actions are to be consistent with the final remedy. Alternative 3N would be consistent with the TCRA in that it would enhance the existing Armored Cap to make it into the proposed Permanent Cap.

2. <u>Removal Of The Armored Cap Would Be An Unprecedented Step</u>. Alternatives 4N, 5N, 5aN, and 6N, in contrast to Alternative 3N, would result in the removal of part or all of the Armored Cap which constitutes a robust, engineered cap, constructed in compliance with USACE cap design guidance. This would be a dramatic and likely unprecedented step in view of the fact that capping is a proven, effective and protective remedy endorsed by USEPA's sediment guidance (USEPA *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (December 2005) (Sediment Guidance) and USACE guidance.[2] As described below, removal of the cap also brings significantly more challenging environmental consequences and risks than strengthening the existing cap.

[2] A detailed list of references is included at the end of this White Paper.

3. **The Armored Cap Has Been Through Several Years Of O&M And Recommendations By The USACE To Strengthen The Cap Have Been Implemented**. The Armored Cap has been through several years of operation and maintenance. A minor disruption of rock (above the geotextile layer) in July 2012 was immediately addressed. The USACE performed an evaluation of the Armored Cap and provided recommendations regarding improvements that have been implemented by the Respondents.

4. **The Permanent Cap Would Withstand Events Greater Than A 100-Year Storm And A 500-Year Flood**. The Armored Cap meets all applicable or relevant and appropriate requirements (ARARs) and under Alternative 3N, the strength and protectiveness of the already enhanced Armored Cap would be further enhanced beyond its current ability to withstand a 100-year storm and 500-year flood event.

5. **Removal Of The Armored Cap Would Cause Resuspension Of Sediment And Possible Increase In Fish Tissue Concentrations**. Under Alternative 3N, the waste is isolated and contained under the Armored Cap, and would not be disturbed, but rather made even more secure. By contrast, under Alternatives 4N, 5N, 5aN, and 6N, the multi-layered Armored Cap would be partially or fully removed to allow the underlying waste material, a portion of which is beneath the waterline, to be dredged, stabilized, and/or removed. Such action will result in resuspension of impacted sediments, potentially resulting in increased fish tissue concentrations of contaminants for several years following disturbance.

6. **Removal Of The Armored Cap Would Significantly Increase The Chance Of Exposure Of The Waste Material To A Storm Or Flood**. While Alternative 3N would further strengthen the Armored Cap without exposing the underlying waste to the environment, Alternatives 4N, 5N, 5aN, and 6N all involve the partial or complete removal of the Armored Cap such that the underlying waste material would be exposed to the environment. A 30 percent to 40 percent chance exists that a significant storm or flood event would occur while the Armored Cap is removed. Such a storm or flood would risk overwhelming any best management practices (BMPs) used to mitigate resuspension of contaminants during normal flow events.

7. The Permanent Cap Minimizes Worker Safety Risks, Environmental Impacts From Emissions And Community Impacts. Alternatives 4N, 5N, 5aN, and 6N will require as many as 17,000 trips by trucks filled with excavated waste material, and present worker safety risks. In addition, greenhouse gas, particulate matter (PM) emissions and ozone impacts are estimated to be more than 8 to 20 times higher than for Alternative 3N. Moreover, traffic and community impacts under these alternatives are estimated to be from 6 to 70 times greater than for Alternative 3N.

8. The Permanent Cap Is The Most Cost-Effective Remedy. The NCP requires that "[e]ach remedial action selected shall be cost effective." Alternative 3N is the most cost-effective of the remedy alternatives. Cost effectiveness is defined as involving "costs [that] are proportional to its overall effectiveness." Alternative 3N effectively and permanently reduces risk in a cost-effective manner (in the range of $12.5 million, inclusive of TCRA construction costs). The other remedies, which range in cost from $23.2 million to $99.2 million, do not provide any material incremental risk reduction as compared to Alternative 3N, and actually involve the potential to create incremental risk and exposure, as a result of impacts to the environment in the form of resuspension, releases and residuals.

Southern Area

The Southern Area is located on a portion of the peninsula south of Interstate Highway 10 (I-10). The remedial alternatives for this area (Alternatives 1S to 4S) address three discrete locations at which subsurface soils contain dioxins above the applicable protective concentration level (PCL) for a hypothetical future construction worker. There are no risks to ecological receptors from the dioxin in this area.

Remedial alternatives for the Southern Area are: 1S (no further action); 2S (ICs); 3S (enhanced ICs) and 4S (removal and off-site disposal). IP performed the RI for the Southern Area and recommends that USEPA select Alternative 2S for the following reasons:

1. Deed Restrictions Can Ensure Protection Of Construction Workers. The only potential risk in the Southern Area is to a hypothetical future construction worker who, in three discrete areas, might come into contact with dioxin above the critical PCL in the soil within the first ten feet below ground surface. This risk can be

effectively avoided through deed restrictions (as provided for in Alternative 2S) which provide notice to future purchasers and construction workers of subsurface site conditions.

2. A Deed Restriction Is Effective On A Long-Term Basis. Alternative 2S meets the applicable ARARs and deed restrictions and will be effective on a long-term basis to protect potential future construction workers.

3. A Deed Restriction Is The Most Cost-Effective Remedy. Consistent with requirements of the NCP regarding cost effectiveness, 2S is the most cost-effective remedy for the Southern Area because no material incremental protectiveness would be achieved by excavating sub-surface soils that are not posing any present unacceptable risk.

1. BACKGROUND

Since 2009, International Paper Company (IP) and McGinnes Industrial Maintenance Corporation (MIMC) have conducted a remedial investigation/feasibility study (RI/FS) for the Site, which is located on the western side of the San Jacinto River where it crosses Interstate Highway 10 (I-10). The RI/FS addresses the area within the USEPA's preliminary Site perimeter (USEPA's Preliminary Site Perimeter), which includes both the Northern Impoundments and the Southern Area.

The results of IPs and MIMCs comprehensive study of environmental conditions within the USEPA's Preliminary Site Perimeter were summarized in a RI Report, which was submitted to and approved by USEPA in May 2013. During the RI/FS process, the Northern Impoundments, used from September 1965 to May 1966, for disposal of paper mill waste, were the subject of a time critical removal action (TCRA). The TCRA included construction of the Armored Cap, which was effective in stabilizing and isolating waste materials in the Northern Impoundments containing dioxins, the primary chemical of concern at the Site. The RI resulted in the collection of data that demonstrated the positive impact of the TCRA on Site conditions.

Following submission of the RI, IP and MIMC submitted a draft and then a revised FS[3] (FS Report) containing a detailed analysis of the potential remedial alternatives for both the Northern Impoundments and the area south of I-10 (Southern Area). The FS evaluates these alternatives relative to the CERCLA FS criteria described in the National Contingency Plan (NCP) located at 40 CFR § 300.430(e)(9). FS Report, Section 4.3. A comparative net risk evaluation (CNRE), as recommended by the USEPA and the National Academy of Sciences Committee on Remediation of PCB-Contaminated Sediments (NRC 2001; USEPA 2005), was used in considering both the benefits of a remedial approach and the risks associated with its implementation (USEPA 2005; Nadeau 2008).

[3] IP and MIMC submitted the Draft Final Interim Feasibility Study on March 21, 2014.

1.1. Remedial Alternatives for the Northern Impoundments

The remedial alternatives for the Northern Impoundments focus on containment, removal, and/or a combination of containment, treatment, and removal together with Institutional Controls (ICs). There are seven alternatives. Implementation of Alternatives 1N and 2N would maintain the Armored Cap in its current form, and Alternative 3N would enhance and increase the long-term stability of the Armored Cap and provide for the Armored Cap to be monitored and maintained without disturbing the material that is already contained and isolated from potential receptors. Alternative 3N would also include measures to protect the Permanent Cap from vessel traffic. Implementation of Alternatives 4N, 5N, 5aN, and 6N would require removing all or part of the Armored Cap, followed by stabilization, or dredging of the underlying waste deposits. Except in the case of the full removal option (6N), when the work was completed, a new cap to replace and upgrade the removed and discarded Armored Cap would then be installed. The estimated cost of these alternatives, details of which are summarized in Table 1 below, range from $9.5 million to $99.2 million.

Table 1

Alternative for Northern Impoundments

Alternatives North I-10	Actions	Construction Period[4]	Cost (Millions)
Alternative 1N (No Further Action)	**Armored Cap and Operations, Monitoring and Maintenance (OMM)** Armored Cap and fencing, warning signs, and access restrictions established as part of the TCRA remain in place and are subject to ongoing OMM. Cost estimate is based on Armored Cap design and construction ($9 million) and 5 –year review costs.	--	$ 9.5

[4] Assumes off-site location is available for staging and material handling. The size, availability and location of available off-site facility could significantly extend the construction period for Alternatives 4N, 5N, 5aN, and 6. (See Sections 4.3 and 5 of the FS).

Alternatives North I-10	Actions	Construction Period[4]	Cost (Millions)
Alternative 2N	**Armored Cap, ICs and Monitored Natural Recovery (MNR)** Armored Cap and fencing, warning signs and access restrictions established as part of TCRA remain in place and are subject to ongoing OMM. ICs in the form of deed restrictions and notices and periodic monitoring to assess the effectiveness of natural recovery processes would be instituted.	--	\$ 10.3
Alternative 3N	**Permanent Cap, ICs and MNR** Additions to the Armored Cap – to flatten slopes, add armor rock and implement measures to protect the cap from vessel traffic impacts – to create the Permanent Cap. Continued OMM of the Permanent Cap. ICs and periodic monitoring of MNR.	2 months	\$ 12.5
Alternative 4N	**Partial Solidification/Stabilization (S/S), Permanent Cap, ICs and MNR** 23 percent of the Armored Cap (2.6 acres above the water surface and 1.0 acre in submerged areas) would be removed. Approximately 52,000 cy of materials now capped containing $TEQ_{DF,M}$ above 13,000 ng/kg kilogram (ng/kg) would undergo S/S. After S/S was completed, the Permanent Cap would be constructed and would remain subject to OMM, ICs and periodic monitoring of MNR.	17 months	\$ 23.2

Alternatives North I-10	Actions	Construction Period[4]	Cost (Millions)
Alternative 5N	**Partial Removal, Permanent Cap, ICs and MNR** 23 percent of Armored Cap would be removed (2.6 acres above water and 1.0 acre submerged). Same 52,000 cy of material as in 4N would be excavated. After excavation, Permanent Cap would be constructed and would remain subject to OMM. ICs and periodic monitoring of MNR as in Alternatives 2N-4N would be required.	13 months	$ 38.1
Alternative 5aN	**Partial Removal of Materials Exceeding the PCL, Permanent Cap, ICs and MNR** 72 percent of AC would be removed (covering areas where water depth is 10 feet or less and has a $TEQ_{DF,M}$ of 220 ng/kg or greater[1], the PCL for a hypothetical recreational visitor). About 137,000 cy of material in those areas would be excavated and landfilled. Remaining 28 percent of Armored Cap would be enhanced to create a Permanent Cap. ICs and periodic monitoring of MNR would be included for Alternative 5N.	19 months	$ 77.5
Alternative 6N	**Full Removal of Materials Exceeding the PCL, ICs and MNR** All material above the PCL of 220 ng/kg either beneath the Armored Cap or at depth in an area to the west would be excavated. Armored Cap would be removed in its entirety 200,100 cy of excavated material would be landfilled.	16 months	$ 99.2

The most optimal and appropriate of these alternatives is the enhanced Permanent Cap (Alternative 3N). Alternative 3N builds on the existing Armored Cap, which has been effective in containing and isolating impacted materials. Unlike those alternatives that require removing all or parts of the Armored Cap during construction, Alternative 3N satisfies the provisions of CERCLA and the NCP cited above that specify that an interim remedy be consistent with the final remedy.[5] It avoids the documented risk of releases and implementation uncertainties associated with the alternatives involving either stabilization or excavation. Finally, given the estimated cost of the stabilization and excavation alternatives, Alternative 3N is the only alternative which satisfies the requirement that a selected remedy be cost effective.

1.2. Remedial Alternatives for the Southern Area

For the Southern Area, the only risk identified during the RI was to a hypothetical construction worker who might, in three discrete locations, come into contact with soil at depths between one and ten feet below ground surface containing dioxins and at levels greater than the applicable PCL. The remedial alternatives applicable to those areas, in addition to the "no further action" alternative (Alternative 1S), include ICs (Alternative 2S), enhanced ICs (Alternative 3S), and removal and off-site disposal (Alternative 4S). The cost of the ICs and enhanced ICs are $270,000 and $670,000 respectively, while the cost of Alternative 4S is $9.93 million. Given the limited nature of the risk, ICs (Alternative 2S) provide the most appropriate and cost-effective remedy.

[5] CERCLA guidance contemplates that such "early action" (before all site investigation and full remedy evaluation have been completed) may be undertaken to promptly address the site conditions but requires that such interim work be consistent with the final remedy for the site.

2. ENHANCING THE ARMORED CAP TO CREATE A PERMANENT CAP (ALTERNATIVE 3N) IS THE OPTIMAL REMEDY FOR THE NORTHERN IMPOUNDMENTS

2.1. Alternative 3N Will Strengthen the Armored Cap to Create a Permanent Cap

Alternative 3N builds on the effectiveness of the Armored Cap (which IP and MIMC designed and constructed at a cost in excess of $9 million). It further strengthens the existing Armored Cap by adding additional armoring, flattening slopes and implementing measures to provide protection from vessel traffic (Permanent Cap).

More specifically, the cap enhancements that are part of Alternative 3N include adding armor rock in various areas of the cap to flatten and reduce the slope from 3H:1V to 5H:1V. The reduced slope will enhance the Armored Cap's resistance to wave and wind action, and add an additional "factor of safety" to the design that exceeds that which is required by USACE and USEPA guidance. It will satisfy design criteria for "no displacement" (as opposed to a "minor displacement" scenario). The Permanent Cap also includes both ICs and physical barriers to protect the Armored Cap from physical impacts from marine traffic operating near the Armored Cap. The need for and scope of further cap protection (e.g., from future barge or other vessel operations in the Armored Cap area) would be assessed and detailed during the remedial design phase.[6]

2.2. The Armored Cap Is Effective in Isolating and Stabilizing Waste Materials in the Northern Impoundments

2.2.1. TCRA Construction and Design

Installation of the Armored Cap has stabilized and isolated waste and sediments within the original 1966 perimeter berm of the Northern Impoundments to prevent the release of dioxins and other chemicals of potential concern to the environment (Anchor QEA 2011,

[6] For purposes of FS cost development, a conceptual submerged perimeter rock berm was included as a component for Alternative 3N to further ensure the long-term protectiveness of the Permanent Cap.

2012a). The TCRA also involved the installation of fencing, the establishment of access controls, and the posting of warning signs.

The Armored Cap, completed in 2011, incorporates armor stone, geotextile, and geomembrane layers over approximately 15.7 acres. It was designed in accordance with USACE guidance and the Sediment Guidance to withstand a 100-year storm event with an additional factor of safety to ensure its long-term protectiveness (USEPA 2005).[7] The storm event defines the depth of water and currents that the cap armor layer must resist. The potential risk to the Armored Cap of even larger storm events, up to a 500-year event, were later evaluated for the FS. This evaluation showed that the Armored Cap is designed and capable of withstanding a 500-year flood event (see Appendix B of the FS).

2.2.2. Monitoring and Maintenance of the Armored Cap

Since July 2011, the Armored Cap and the associated fencing, access controls, and signs have been routinely inspected and maintained by IP and MIMC pursuant to a USEPA-approved OMM Plan (Appendix N of the Removal Action Completion Report, Anchor QEA 2012a). The OMM Plan was developed to address conditions that the USACE and USEPA cap design guidance expressly presumes could occur post-construction (such as movement of rock cover in localized areas of a cap). The OMM Plan requires periodic monitoring (and monitoring following key storm events) to identify the need for possible cap maintenance, followed by appropriate repair activities (USEPA 2005; USACE 1998). Typically, the first few years following cap construction are a period during which monitoring and maintenance may need to be performed more frequently; this is contemplated by the OMM Plan, which calls for more frequent (quarterly) monitoring during the first years after construction is completed.

In July 2012, minor disruption of a localized area of the armor layer (the rock above the geotextile layer) of the Armored Cap occurred. The affected areas (along the western berm slope) totaled approximately 200 square feet, or 0.03 percent of the overall area of the

[7] In addition to a 100-year storm event, storms with 5- and 10-year return intervals were also considered during the TCRA design because it was recognized that more frequent storms could present more critical design conditions; for these more frequent storms, the water depth would be lower, which could result in higher shear stresses on the cap compared to a less frequent storm such as the 100-year design event.

Armored Cap. Importantly, there was no exposure of material contained beneath the Armored Cap and no release of hazardous substances associated with this temporary condition.

This disruption was recognized during a scheduled inspection of the Armored Cap and was promptly addressed in accordance with the approved OMM Plan, with USACE and USEPA guidance. The area was addressed using locally available materials that had been stockpiled for that purpose. These maintenance activities were completed in July 2012 and were documented in a completion report for USEPA (Anchor QEA 2012b). No similar issues have been identified during subsequent monitoring events, which have demonstrated the continuing effectiveness of the Armored Cap in isolating and containing impacted materials.

2.2.3. Reassessment of the Armored Cap Design and Construction

At USEPA's direction, IP and MIMC subsequently conducted a post-construction evaluation of the Armored Cap. A separate assessment conducted by the USACE on behalf of the USEPA was also performed, resulting in a report dated November 2013 (USACE Report). The USACE Report confirmed the validity of the Armored Cap's design and contained recommendations to address certain construction issues that may have contributed to the July 2012 maintenance event and if implemented, would improve the Armored Cap's long-term protectiveness (USACE 2013). In January 2014, IP and MIMC implemented the USACE' recommendations, which advised flattening certain slopes and adding armor rock in selected areas. This enhancement work was conducted with larger-sized stone than recommended by the USACE, resulting in a more stable and protective cap configuration, exceeding design criteria specified in the USACE and USEPA sediment capping design guidance (USACE 1998). This work was documented in a completion report prepared for USEPA (Anchor QEA 2014, Appendix B).

2.3. The TCRA's Armored Cap Has Been and Will Continue to be Effective and Protective, Particularly As Enhanced to Create a Permanent Cap

The effectiveness of the TCRA is also demonstrated by evaluating post-TCRA conditions and considering the impact of the TCRA on the five Remedial Action Objectives (RAOs) for the

Site. The Armored Cap's design is further confirmed through additional modeling performed as part of the FS to evaluate impacts from storms larger than a 100-year storm.

As discussed in Section 3.2 of the FS Report, implementation of the TCRA achieved the RAOs for the area north of I-10. Specifically, construction of the Armored Cap has eliminated direct contact exposure for people, fish, and shellfish to wastes in the Northern Impoundments and sediments exceeding the PCL. In addition, as shown in the TCRA Armored Cap porewater assessment in Section 5.3 of the RI Report (Integral and Anchor QEA 2013), sampling was completed on surface water and porewater within the Armored Cap with solid-phase microextraction fibers following the Armored Cap construction; the results of that evaluation showed that 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF) were not present at detectable levels in surface water over the Armored Cap.

The modeling of cap performance carried out as part of the reassessment of the Armored Cap and incorporated and addressed in the FS Report demonstrates the ability in the Armored Cap to withstand wind and wave action, including a 100-year storm and 500-year flood event.

2.4. Capping Is a Proven, Effective and Protective Remedy Endorsed by USEPA's Sediment Guidance and USACE's Capping Guidance

In situ capping, as discussed in USEPA and USACE guidance (USEPA 2005; USACE 1998), is a proven technology that has been selected by USEPA for numerous sediment remediation sites across the United States. For example, in the Pacific Northwest, there are caps with more than 20 years of documented protectiveness. Additional examples are identified in Table 4-1 of the FS. The Armored Cap was designed in accordance with USEPA and the USACEs capping guidance (USACE 1998) to withstand a 100-year storm event with an additional factor of safety to ensure long-term protectiveness. Many of the conditions identified in Highlight 5-1 of the Sediment Guidance as especially conducive to capping are present here, and include:

- Suitable types and quantities of cap material are readily available;
- Anticipated infrastructure needs (e.g., piers, pilings, buried cables) are compatible

with the cap;

- Water depth is adequate to accommodate the cap with anticipated uses (e.g., navigation, flood control);
- Incidence of cap-disrupting human behavior, such as large boat anchoring, is low or controllable;
- Long-term risk reduction outweighs habitat disruption, and/or habitat improvements are provided by the cap;
- Hydrodynamic conditions (e.g., floods, ice scour) are not likely to compromise the cap or can be accommodated in the design;
- Rates of ground water flow in the cap area are low and not likely to create unacceptable contaminant releases;
- Sediment has sufficient strength to support the cap (e.g., higher density/lower water content, depending on placement method);
- Contaminants have low rates of flux through the cap; and
- Contamination covers contiguous areas (e.g., to simplify capping).

Sediment caps are designed with requirements for ongoing OMM in mind. The USACE and USEPA cap design guidance expressly presumes that there is some magnitude event that could dislodge localized areas of the cap, and that monitoring (triggered based on key storm events) should be performed to identify the need for possible cap maintenance, followed by appropriate repair activities (USACE 1998). The design guidance recommends that "event-based" monitoring be used to fine tune the OMM program after monitoring the performance of the cap following specific storm events. Typically, in the first few years following cap construction, there is a period where monitoring and maintenance practices identify and address areas of the cap that need to be enhanced, if any, so that the long-term protectiveness of the cap can be ensured. For example, two sediment caps with demonstrated performance for more than 20 years have followed this progression. The St. Paul Waterway cap (USEPA 2004) and the Eagle Harbor cap (USACE 2012), constructed in the late 1980s and early 1990s, respectively, required some early maintenance in their first few years (e.g., placement of additional, coarser material in an erosional area on the St. Paul Waterway cap). Subsequent monitoring has demonstrated the continued protectiveness of these sediment caps.

Source control prior to conducting remediation is critical to the overall effectiveness of any sediment cleanup (Section 2.6) (USEPA 2005). Placement of the Armored Cap was a proven technique for reducing both the short- and long-term risk of exposure to contaminated sediments. The Armored Cap serves as an effective remedy for long-term source control while minimizing short-term impacts to the environment and accelerating risk reduction. Alternative 3N will provide continued robust isolation and protection of dioxin-impacted materials.

The Permanent Cap (Alternative 3N), designed to be protective under a 500-year flood event, will provide the most effective remedial option. Flattening the slopes of the Armored Cap to create the Permanent Cap would further enhance the structural integrity and long-term reliability of the Armored Cap.

3. USEPA SHOULD REJECT THE REMAINING ALTERNATIVES (ALTERNATIVES 4N TO 6N) THAT INVOLVE DREDGING RISKS AND REDUCED EFFECTIVENESS

3.1. Construction Risks Inherent in Dredging Reduce the Potential Effectiveness of Stabilization and Removal Options (Alternatives 4N to 6N)

The Sediment Guidance states that there should not be "necessarily a presumption that removal of contaminated sediments from a water body will be necessarily more effective or permanent than capping or MNR." Section 3.4. Consistent with this direction, any perceived benefit resulting from stabilization or permanent removal of impacted material must be considered in the context of the risks that removing the Armored Cap and dredging and excavation of sediments may increase potential harm to human health and ecological receptors due to increased exposure to contaminants resuspended in surface water (USEPA 2005; NRC 2007; Bridges et al. 2008). These risks can remain even with the effective use of BMPs. For example, approximately 2.2 percent of the mass of contaminants dredged were released downstream at the Fox River Deposit 56/57 dredging project (Steuer 2000). In recent years, the effectiveness of silt curtains in controlling releases has been questioned (Bridges et al. 2008).

USEPA's Sediment Guidance provides: "Some contaminant release and transport during dredging is inevitable and should be factored into the alternatives evaluation and planned for in the remedy design." The Guidance goes on to state that "Generally, the project manager should assess all causes of resuspension and realistically predict likely contaminant releases during a dredging operation." (p. 6-22). Table 4.2 of the FS gives several examples of projects where sediment removal using various dredging techniques resulted in the resuspension of contaminants.

There are also implementation and residual risks associated with dredging operations. Implementation risks associated with dredging remedies may include impacts on the community (e.g., noise, accidents, and residential disruption), construction-related risks to workers during sediment removal, and disruption of the benthic community (USEPA 2005). The residual risks are the following (Patmont and Palermo 2007; Bridges et al. 2008):

- Undisturbed residuals found at the post-dredge sediment surface that have been uncovered, but not fully removed as a result of the dredging operation

- Generated residuals that are dislodged or suspended by the dredging operation and are subsequently redeposited on the bottom either within or adjacent to the dredging footprint

Such risks are often related to residuals (i.e., contaminated sediments) remaining in the aquatic environment once dredging has been completed (USEPA 2005; NRC 2007; Bridges et al. 2008). Implementation and residual risks are site and remedy-specific and must be considered during remedy evaluation and selection (USEPA 2005). Importantly, a fully protective remedy can be achieved without such risks through Alternative 3N.

3.2. Dredging Resuspension and Release Case Studies Demonstrate the Risks Associated with Dredging Remedies

Operational and engineering controls (rigid and flexible barriers) are often used to the extent practicable to mitigate potential releases; however, the effectiveness of operational controls has not been documented, and in some attempts, operational controls have actually increased the resuspension of sediments during dredging (USACE 2008b). Case studies have shown that engineering controls used to control impacts from dredging, such as sheetpiles, may have limited effectiveness; are subject to leakage; accumulate resuspended sediments at the base of the walls, which is impossible to completely capture; and have other technical limitations (USACE 2008b; Anchor Environmental 2005; Anchor QEA and Arcadis 2010). Further, rigid barriers can pose unintended consequences such as concentration of dissolved-phase chemicals, localized scour adjacent to the barrier, and the spread of contaminants during their removal (Konechne et al. 2010; Ecology 1995; Anchor QEA and Arcadis 2010). Flexible barriers, such as turbidity curtains, will suffer from losses because these types of barriers are not truly water-tight (USACE 2008b; Anchor Environmental 2005; Francingues and Palermo 2005; Anchor QEA and Arcadis 2010; USACE 2008a).

Case studies have shown that some dredging-based cleanup remedies have in certain instances increased fish tissue concentrations of chemicals of concern (COCs), often for several years following completion of dredging (e.g., at the Commencement Bay and Duwamish Waterway Superfund Sites; Patmont et al., 2013). The circumstances at the

Grasse River and many other sites are of serious concern at this Site as well, because dioxins and PCBs are similar types of chlorinated chemical compounds; they are hydrophobic and bioaccumulative and have similar characteristics with regard to chemical fate and transport and bioaccumulation in aquatic environments. During the 1995 Non-Time Critical Removal Action (NTCRA) in the Grasse River, caged fish deployed along the perimeter of a set of three silt curtains for 6 weeks showed several-fold increases in polychlorinated biphenyl (PCB) concentrations compared to those observed in the pre-dredging period (NRC 2007). Lessons learned from the 1995 NTCRA and dredging projects at other sites over 10 additional years did not prevent a similar impact to Grasse River fish during the 2005 Remedial Options Pilot Study dredging (NRC 2007). The PCB concentrations increased substantially in fish during the 2005 dredging pilot (NRC 2007).

3.3. There are Site-Specific Dredging Risks of Alternatives 4N to 6N That Would Reduce The Effectiveness of Each of Those Alternatives

Risks associated with implementation of Alternatives 4N, 5N, 5aN, and 6N include the potential for some resuspension and release of dioxins into the water column outside of the work area. These stabilization and/or dredging-based alternatives would each require the removal of the existing Armored Cap to access the target material. Based on the history of resuspension, releases, and residuals identified by the USEPA, National Academy of Sciences, the USACE, and others, and despite use of best management practices (BMPs), there is the possibility that some of these risks would occur during implementation of these alternatives at the Site.

3.3.1. There is a Possibility of a Storm Event During Construction That Could Result in Widespread Dispersal of Material

The weather is out of everyone's control, and if a significant storm or flood were to occur during construction of a dredging-based remedy, any controls that may be instituted to control dredging residual releases under normal flow conditions would be overwhelmed. For Alternatives 4N, 5N, 5aN, and 6N, each of which requires removal of all or portions of the Armored Cap during construction, the consequences of flooding could be significant: exposed, disturbed materials would be at risk of spreading beyond the remedial area.

For each of these alternatives, modeling included with the FS predicts a 30 to 40 percent likelihood that such a flood could occur during construction while the Armored Cap is removed to allow stabilization or removal of the underlying waste material. The actual risk of such an event – were one of these alternatives to be selected – may be even more significant. These alternatives involve significant implementability risks associated with the need for an off-site staging area, and in the case of Alternatives 5N, 5aN, and 6N, the management of large volumes of excavated materials. The flood event estimates developed for the FS are based on projected construction periods that assume access to an off-site work area in a location that is sufficiently large to efficiently handle the material removed from, and being transported to the work site. The risk associated with availability of a suitable off-site location are particularly significant for Alternatives 5aN and Alternative 6, because of the volume of material involved under those alternatives. If a suitable property is not available nearby, that would impact the construction period for these alternatives. Any extension of the construction period would increase the likelihood of a flood during construction.

3.3.2. Modeling Performed for the FS Demonstrates the Potential for Impacts of Releases and Resuspension Associated with Dredging and Construction Activities in Implementing Alternatives 4N to 6N

The modeling presented in Appendix A of the FS demonstrates short-term water column impacts associated with the stabilization and dredging alternatives. For example, the model simulation of Alternative 6N indicates that for an assumed dredge release rate of 3 percent (based on experience from other dredging projects; see Table 5-2 of the FS), average surface water 2,3,7,8-TCDD concentrations within the USEPA's Preliminary Site Perimeter would be predicted to increase by more than an order-of-magnitude above ambient conditions during dredging. These releases would also be expected to increase fish tissue concentrations in the early years following remedy implementation and also result in slight increases in surface sediment concentration in surrounding areas (see Appendix A of the FS for additional details).

To minimize the potential for release of impacted sediment during construction, the work area would need to be protected with a turbidity barrier or silt curtain. The remedy would be intended to achieve full protection upon completion of construction; however, the risk of potentially significant releases of dioxins to the surrounding environment during implementation remains despite the vigorous implementation of BMPs, risk which would be unavoidable and would affect the water column, increase sediment concentrations beyond the work area, and potentially increase tissue concentrations of COCs in aquatic receptors (fish and shellfish).

3.3.3. Alternatives 4N to 6N Also Involve Additional Short-Term Environmental Impacts

In addition to these environmental risks, the construction duration for the stabilization and removal alternatives result in significantly higher greenhouse gas, particulate matter (PM), and ozone impacts relative to Alternative 3N associated with construction emissions from equipment operating in the work areas (see Table 4-4 of the FS), as well as from equipment required for off-site transportation and disposal of excavated sediments. From a worker safety perspective, there is a higher risk of accidental injury to workers during construction (See Table 4-5 of the FS). In sum, all these risks are avoidable only by selecting an alternative that avoids the removal in the first place and provides full and adequate protection on-site.

4. Alternative 3N Is the Only Alternative That Meets CERCLA's Cost-Effectiveness Requirement

Pursuant to the USEPA's 1999 guidance, A Guide to Preparing Proposed Plans, Records of Decision, and Other Remedy Selection Documents, "cost-effectiveness is concerned with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs compared to other available options." Moreover, "if the difference in effectiveness is small but the difference in cost is very large, a proportional relationship between the alternatives does not exist" (Preamble to NCP). (55 Fed. Reg. 8728 (3/8/90)). These proportionality requirements were reiterated by USEPA in Section 7-1 "Risk Management Decision Making" of the Sediment Guidance (USEPA 2005) as follows, "A risk management process should be used to select a remedy designed to reduce the key human and ecological risks effectively. Another important risk management function generally is to compare and contrast the costs and benefits of various remedies." (p. 7-1).

Costs for the response action alternatives for the Northern Impoundments range from $9.5 to more than $99 million. Alternatives 1N and 2N have similar costs, primarily related to long term OMM of the Armored Cap. Alternative 3N has a higher cost than Alternatives 1N and 2N because it also includes construction of the Permanent Cap and the associated OMM, as well as the implementation of measures to protect the cap from vessel traffic.

Costs for Alternatives 4N, 5N, 5aN, and 6N are exponentially higher than for Alternatives 1N, 2N, and 3N. This reflects the challenges of establishing and operating an off-site staging and processing area, removing the Armored Cap (and then for some alternatives, replacing it with a Permanent Cap), in situ treatment or excavation and associated engineering controls, the quantity of materials being addressed, the duration of work, and the high cost of transportation and disposal of dioxin-impacted sediments.

The figure below compares the overall project cost and projected effectiveness for each of the alternatives.

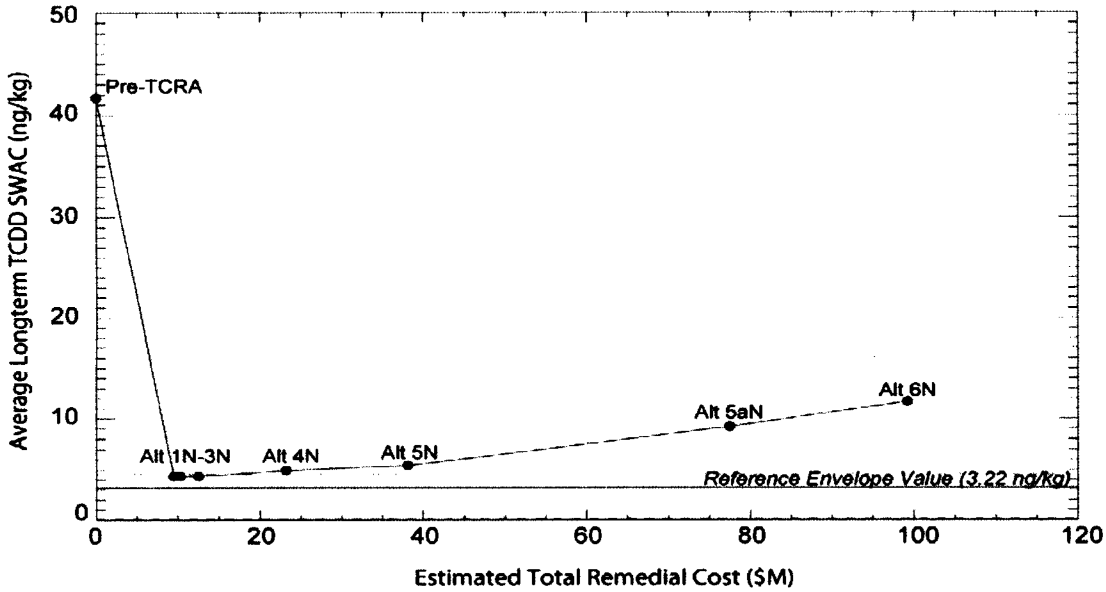

Figure 1 - Overall Project Cost and Effectiveness

Figure 1 demonstrates that Alternatives 1N, 2N, and 3N provide an equal reduction in the surface-weighted average concentration (SWAC) of dioxins in sediments in the river within the USEPA's Preliminary Site Perimeter. However, for Alternatives 4N, 5N, 5aN, and 6N, the SWAC for dioxins in sediments in the river are predicted to increase due to dredging-related impacts. While Alternatives 5N, 5aN, and 6N would remove materials with higher dioxin concentrations, they would reduce—rather than increase—the protectiveness of the remedy because of the impacts from construction. These alternatives are also incrementally and substantially more expensive because of their complexity and duration. Further, even assuming that no resuspension, other impacts, or residuals would occur during implementation of Alternative 4N, 5N, 5aN, or 6N (a situation that has not been observed at any environmental dredging project to date), no incremental protectiveness in the SWAC would occur as a result of the implementation of any of these alternatives, yet there would be a substantial and disproportionate increase in cost. Hence, these alternatives would not be considered cost-effective under CERCLA and the NCP because they would not provide meaningful additional protectiveness in comparison to the disproportionate incremental cost.

Based on the evaluation of the potential incremental risk reduction as compared to the incremental costs of alternatives for the Northern Impoundments, Alternative 3N clearly is the most cost-effective remedy as defined in the NCP and has the additional advantage of presenting a fully protective remedy; more protective than more expensive options.

The remedy evaluation at this Site should follow the risk management and cost-effectiveness requirements of CERCLA and the NCP by focusing on the alternative with costs that are proportional to the remedy's anticipated effectiveness (risk reduction). Based on the considerations presented in the FS Report, Alternative 3N is the superior choice. Alternatives 4N, 5N, and 6N each offer less environmental benefit or reduction in risks, greater uncertainties related to implementation, an extended construction schedule, higher short-term environmental impacts, increased safety risks, higher community impacts, and fail to meet the cost-effectiveness requirement of the NCP.

Applying the principles set forth in CERCLA and the NCP on protectiveness, management of short and long-term risk, risk management and the comparative net risk decision-making and the requirement of cost-effectiveness to ensure proportionality between risk reduction and cost, Alternative 3N clearly stands out as the preferred alternative for the Northern Impoundments.

5. ALTERNATIVE 2S IS THE PREFERRED REMEDY FOR THE SOUTHERN AREA

The RI has demonstrated that any risks from dioxin-impacted soils in the Southern Area pose a risk only to a hypothetical construction worker who might disturb soil at depths up to ten feet in three specific areas. The shipping industry operations in the vicinity of the Southern Area lend themselves to the implementation of a remedy involving ICs under which property owners would be alerted to the presence at depth of the impacted soil and of the need to take precautions when excavating in specific locations.

Other than No Further Action (Alternative 1S), the remedial alternatives for the Southern Area address both of the CERCLA threshold criteria as established in the NCP: protectiveness and compliance with Applicable or Relevant and Appropriate Requirements (ARARs). Alternative 4S offers the benefit of permanent removal of impacted soil from the 0- to 10-foot interval, but the risk management achieved by ICs is nearly equivalent, particularly with the addition of the physical markers that are part of Alternative 3S. Alternatives 2S and 3S would not require exposing impacted soil or transporting material off- site and would be simpler to implement. Excavation of impacted soil (Alternative 4S) would introduce short-term risks of exposure on-site and potentially off-site should a release occur en route to the disposal facility.

The cost of Alternative 4S, $9.93 million, is nearly 15 times the cost of Alternative 3S and nearly 35 times the cost of Alternative 2S. Alternative 4S does not satisfy the NCP requirement that a remedy be cost-effective, because it does not provide meaningful additional protectiveness in comparison to the disproportionate incremental cost.

Alternative 4S offers a marginal increase in long-term effectiveness by removing the impacted soil; however, there is an increased short-term risk of exposure and potential traffic accidents. Alternatives 2S and 3S effectively mitigate potential risks associated with exposure to soil in the Southern Area with reduced short-term exposure risks and at costs commensurate with the potential risk associated with the impacted soil at depth. Based on the NCP proportionality provisions, Alternative 2S is the highest ranked alternative when applying the NCP's remedy selection criteria [Part 300.430(e)(9)]. Alternative 2S is also the most cost-effective remedy for the Southern Area, in that no material incremental protectiveness would be achieved by excavating subsurface soils that are not posing any present unacceptable risk.

Applying the principles set forth in CERCLA, and the NCP on protectiveness, management of short and long-term risk, risk management and the comparative net risk decision-making, and the requirement of cost-effectiveness to ensure proportionality between risk reduction and cost, Alternative 2S clearly stands out as the preferred alternative for the Southern Area.

6. APPLICATION OF THE NCP'S NINE CRITERIA TO THIS SITE CLEARLY AND UNEQUIVOCALLY IDENTIFIES ALTERNATIVES 3N AND 2S AS THE OPTIMAL REMEDIES FOR THE SITE

Alternatives 3N and 2S are fully consistent and compliant with the provisions of CERCLA and the NCP, including the "Nine Criteria" contained in NCP (Section 300.430(e)(9). Applying the NCP's Nine Criteria to Site-specific conditions results in an obvious choice for the final remedy for each of the two areas of the Site: Alternative 3N for the Northern Impoundments and Alternative 2S for the Southern Area. The analysis of the recommended Alternatives 3N and 2S under the NCP criteria follows below.

6.1. Overall Protection of Human Health and the Environment

Alternative 3N provides optimal protectiveness as compared with the other alternatives for the Northern Impoundments. It strengthens the existing protective Armored Cap by adding additional armor rock and flattening slopes and by creating protection from vessel traffic to create the Permanent Cap. The Permanent Cap is designed to exceed USEPA and USACE design guidance and to withstand a 100-year storm event and a 500-year flood event. In contrast, Alternatives 4N through 6N would require removal of some or all of the Armored Cap in order to either dredge or stabilize the underlying waste deposits and are all likely to result in resuspension and releases during construction and thereafter that would substantially decrease their protectiveness. Moreover, as compared to Alternative 3N, Alternatives 4N through 6N would result in higher risk of worker injury during construction and risks stemming from up to 17,000 trips by trucks filled with hazardous materials and the resulting emissions from those trucks.

Alternative 2S, employing ICs, is also fully protective because the only potential future risk identified in the Southern Area is from disturbance of subsurface soils in three discrete areas. The only exposure scenario would be to hypothetical future construction workers. This risk can be effectively avoided through the typical CERCLA institutional control tool of deed restrictions, which would provide notice to future purchasers and construction workers of subsurface site conditions.

6.2. Compliance with ARARs

Alternatives 3N and 2S are fully compliant with the ARARs identified for their respective remedial components during their implementation at the Site.

6.3. Long-Term Effectiveness

Alternative 3N will utilize a proven remedial technology, capping, which is specifically endorsed as one of the key remediation methods in the Sediment Guidance (Chapter 5) as well as the USACE capping guidance (USACE 1998). Despite the protectiveness of the existing Armored Cap and its exceedence of the USACE's design guidelines, Alternative 3N will further bolster the strength and protectiveness of the Armored Cap. In addition, long term monitoring and maintenance of the Permanent Cap will ensure its long-term effectiveness. Alternative 3N will also include measures to protect the cap from vessel traffic.

Alternative 2S also will be effective on a long-term basis because it is based on the existing Site conditions which do not present any unacceptable surface soil issues. ICs involving a permanent deed restriction will provide appropriate notice to current and future owners and correspondingly, to potential future construction workers about the risks potentially present in subsurface soils.

6.4. Reduction of Toxicity, Mobility and Volume through Treatment

Alternative 3N does not provide additional reduction of toxicity, mobility and volume (TMV) due to treatment beyond that achieved during the TCRA. During the TCRA, the most significantly impacted sediments at the Site, found in the Western Cell, were treated and their mobility reduced via solidification and stabilization. Risk reduction would be further achieved under Alternative 3N by the construction of the Permanent Cap, the use of ICs and monitoring to verify that clean sediment layers continue to prevent potential exposure pathways at locations outside the Permanent Cap, and by implementing measures to protect the cap from vessel traffic. Neither Alternative 2S nor any of the other alternatives for the Southern Area include TMV, because of the nature of the alternatives under consideration.

6.5. Short-Term Effectiveness

For purposes of short-term effectiveness, Alternative 3N is clearly superior to Alternatives 4N through 6N due to the inevitable resuspension, release and residuals risks to the environment during the dredging/excavation component of those remedies (See Sections 6.5.5 [Resuspension and Releases] and 6.5.7 [Residuals] of the Sediment Guidance (USEPA 2005) and the Army Corps 4Rs publication (USACE 2008a)). Worker safety risks, greenhouse gas, PM emissions, and ozone impacts are estimated to be more than 8 to 20 times higher for Alternatives 4N, 5N, 5aN, and 6N compared to Alternative 3N. Traffic and community impacts for Alternatives 4N, 5N, 5aN, and 6N (measured as truck trips) are estimated to range from 6 to 70 times greater than Alternative 3N. As is shown in Figures 6-1a, 6-1b, 6-2, and 6-3 of the FS, removal and solidification-and stabilization-based Alternatives 4N, 5N, 5aN, and 6N have potential short and long-term impacts due to releases during construction; in contrast, Alternatives 1N, 2N, and 3N do not have similar impacts to sediments and water column concentrations.

With respect to Alternative 2S, there are no short-term effectiveness issues, compared to some minimal short-term risks under Alternative 4S, resulting from potential risks to the community, ecological receptors and workers.

6.6. Implementability

There are very limited potential implementability concerns about Alternative 3N, based on the successful construction of the Armored Cap during the TCRA, as well as the multitude of successful cap installations around the world. In contrast, there would be more challenging implementation issues with Alternatives 4N through 6N as result of the need to stabilize soils and sediment while working in a floodplain and subtidal areas. In addition, Alternatives 4N through 6N may involve significant challenges relative to locating property at which the excavated waste materials may be managed prior to shipment to an offsite landfill for disposal.

There are no implementability issues with Alternative 2S.

6.7. Cost

Alternative 3N is the most cost-effective alternative as defined under both CERCLA and the NCP, which require that remedies be cost-effective (42 U.S.C. §9621(a); 40 CFR §300.430(f)(1)(ii)(D)): "Each remedial action selected shall be cost-effective" (40 CFR §300.430(f)(1)(ii)(D)). Cost-effectiveness is defined as "costs are proportional to its overall effectiveness." (40 CFR §300.430(f)(1)(ii)(D)). Alternative 3N effectively and permanently reduces risk in a cost-effective manner (with costs in the $10 million range) when compared to the other remedies (ranging from $12.5 million to $99 million). The other remedial alternatives do not provide any material incremental risk reduction, and run the risk of creating incremental risk and exposure as a result of impacts to the environment in the form of resuspension, releases, and residuals.

Therefore, based on application of the NCP criteria and Sediment Guidance policies to Site-specific conditions, Alternative 3N is the clear choice to address the Northern Impoundments. Likewise, Alternative 2S is the most cost-effective remedy for the Southern Area, because no material incremental protectiveness would be achieved by excavating subsurface soils that are not posing any present unacceptable risk.

6.7.1. Modifying Criteria

State acceptance and community acceptance have yet to be determined and are not addressed in this analysis.

6.7.2. Conclusion

In conclusion, Alternatives 3N and 2S are the highest ranked alternatives when applying the NCP's remedy selection criteria [Section 300.430(e)(9)]. Based on application of the NCP criteria as well as the Sediment Guidance and USACE guidance to Site-specific conditions, Alternative 3N is the clear choice to address the Northern Impoundments and Alternative 2S is the clear choice to address the Southern Area.

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